Specification Amendments

Abstract of the Disclosure

Portable personal water purifier with a microdischarge array sealed with a radiation emitter, preferably XeI, slightly above atmospheric or water pressure in a closely-configured treatment chamber. Each array is a polyimide film separating a copper layer or mesh cathode surface from a conductor pattern of nickel anodes at UV pixel via sites __,__~~. The sealed microdischarge array is~~ juxtaposed in effective purifying range of all the water. In a canteen embodiment, the array is presented as a divider in the water chamber, or at its sides. In a continuous-flow embodiment, the array is presented as a spiral flow-through packet between input and output connections axial to a cylindrical water jacket. Battery or plug power is provided, along with any desired input filter. Two microdischarge arrays are preferably sealed in a twin-pack about a set of stiffener rods, ~~which may~~ extending outward for re-assembly in ~~positioning~~ sockets after cleaning. Other separation assurance devices are spiral and chain separators.

Figure 4 is a top view and inset cross-sectional view of a microdischarge pixel site, illustrating operation of a single pixel site, representative of prior art.

Figure 5 is a photomicrograph of a 10 x 10 portion of a microdischarge array representative of prior art.

Figure 6 is a composite graph, known to prior art, showing relative intensities of XeI (B->x) fluorescence and Hg resonance line at 253.7 nm produced by a low-pressure capillary discharge lamp.

Figure 7 is a cross-sectional schematic view of a microdischarge pixel cavity of total thickness approximately 30 μm. The inset is a screen electrode in place of the cathode sheet.

Figure 8 is ~~a photograph of a laminated microdischarge cavity, typical of prior art~~ showing of spiral 8.

Figure 9 is a schematic depiction of a pattern exposure system (prior art) for providing the microdischarge array.

Figure 10 is a preferred high production system (prior art) showing high-speed patterning of microdischarge arrays.

Figure 11 is a selection of separation assurance means, including extending stiffener rods_, shown juxtaposed with spiral 8 of Fig. 8.

Figure 2 shows two configurations for the interior of the FUMP. Either the spiral shape or the parallel plate configuration limits the maximum distance between any portion of the water and a microdischarge UV emitter to 5-10 mm, and effective radiation travel in water. In doing so, it ensures that the UV transmission, and consequently, maximum disinfection, is maintained throughout the volume of water. In addition, these two configurations are designed for easy disassembly and cleaning to remove any fouling that may accumulate on the FUMP (over time). For example, the spiral-mounted FUMP is simply unrolled and wiped down and then easily re-wound into the spiral configuration. Spacing assurance for the FUMP is provided by plastic spiral 8, holding the carbon pre-filter cartridge 3 in place and separating the layers, or spiral 9 at the other end of the FUMP 4 <u>enclosed by end cap 10.</u>. Other spacing assurance means will be discussed later. Finally, the length of the FUMP is tailored to ensure that the water receives enough UV radiation, as it flows, to complete the disinfection. This length of the FUMP will be comparable to the length of conventional low-pressure mercury arc lamps.

Figure 3 shows the second embodiment of the portable, UV-based water purification system, the large canteen 11. This configuration is designed to take full advantage of the flexibility of the FUMP ~~4~~. As shown, it incorporates the microdischarge array 5 along the interior of a five-quart collapsible water carrier, which is a standard size issued to field soldiers. Once emptied, the water carrier can be rolled to pocket size. Additionally, this design has the advantage of enabling the filling process (and speed) to be decoupled from purification. That is, the water carrier can be filled at very high speed, and purification can be performed at any time (prior to drinking). For example, in time-critical situations, soldiers could simply fill their canteens as quickly as possible without restriction on flow rates for purification purposes. For safety, the design incorporates an indicator cap 12 to confirm that the water has been purified prior to drinking. Such an indicator can be used to track the time to clean the unit or replace the filter cartridge.

Operation is much the same as in the in-line unit. Water of unknown purity is filtered and passed along the radiation emitting surface of the FUMP, from an input position to a potable storage and output portion. Dimensions are kept within limits so the radiation can penetrate the water as it passes. Battery pack 6 operates similarely the battery pack 6 in Fig. 1. Zippers 13 allow access within outer cover 14 to inner container 15.

~~Figure 8 shows an example of how these~~

These microdischarge arrays can be sealed through conventional lamination. Operating voltages as low as 114 V were observed at 700 torr of Ne and device lifetimes were in excess of 50 hours. It has been determined that the microdischarge arrays can be refilled with new gas at the end of their useful life and then deliver the same performance. Thus, the primary limiting factor in the lifetime of the arrays is the outgassing of the barrier materials.

Separation Assurance

Figures 11-13 show diagrammatically how separation of adjacent layers of sealed microdischarge array is required for effective fluid flow of the selected fluid, usually water having suspected pollution. Separation must be limited to approximately 2.5 centimeters for effective radiation disinfect capability. Accordingly, it is preferred to group together two sealed microdischarge arrays, as shown in the inset to Figure 13, and to seal together those two grouped sealed microdischarge arrays about a set of stiffener rods 21 as shown. One reason for sealing the two sealed microdischarge arrays together is to permit them to be individually made and tested before being cemented or otherwise sealed about the set of stiffener rods. Another reason is that the two sealed microdischarge arrays thus may be taken out of the water chamber as a unit for cleaning, requiring only a simple wiping operation on the outside surface of each, and then the double-sealed, stiffener rod reinforced, twin microdischarge array unit may be re-rolled for return to the water chamber for use. Representative stiffener rods 21 are not in contact with the water in the active radiation area, and thus are largely exempt from fouling. In case of damage in the field, the throwaway unit during field operations may be the double-sealed twin sealed

microdischarge array unit 30, with integral stiffeners 21, shown in Figure 13. Under more normal circumstances, however, the double-sealed twin microdischarge array 30, with integral stiffeners 21 ~~29~~ , may be repaired or remanufactured, usually by taking the damaged sealed microdischarge array away, replacing it and sealing it to the undamaged other sealed microdischarge unit with its stiffener rods 21 still in place. The stiffener rods, at least some of them, preferably protrude outside the double-sealed twin package, to be used for placement in mating sockets in the cylinder or rectangular chamber.

15 For military use in the field, a double-package of single sealed microdischarge array units 30a and 30b (Fig. 13 inset or Figs. 14-16)) may be preferred without extending stiffener rods, or without any stiffener rods as shown in Figs. 15-16, where stiffener rod holder 26 serves as separation assurance. The sealed unit may use one or more spiral separators 8 or 9 for separation assurance, or may use one or more chain separators 31. The sealed microdischarge array is simply laid out flat, chain separators are placed flat with appropriate grippers on the surface of the sealed unit in the direction of rolling, and then rolled up with the sealed unit. The separation-assured configuration can then be inserted into the cylindrical housing of the microdischarge array unit 1.

Note that all separation assurance devices permit reasonable fluid flow. In most embodiments, fluid flow is maintained unidirectional, by means such as check valves, to prevent self-contamination.